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Dipole Requirements for SAR System Validation and Verification

General Requirements

Dipoles are specified in SAR measurement standards for validating SAR system performance and verifying routine measurement accuracy. These dipoles are optimized for measurement repeatability and lab-to-lab reproducibility in configurations required by measurement standards. The detailed dipole design parameters are specified at selected frequencies in these standards to ensure acceptable electrical and mechanical tolerances can be specified. Specific test configurations are also defined to enable SAR to be measured within 10% of the defined SAR target values. These targets have been derived using both numerical simulations and experimental validation in measurement configurations defined in the measurement standards.

Dipole Requirements

The dipole SAR targets must be validated according to the numerical simulation and experimental validation protocols used in developing the published target values in SAR measurement standards; for example, IEEE Standard 1528-2003. After the initial numerical and experimental validations, regular calibrations are necessary to reconfirm the electrical specifications and SAR targets of the dipoles. If a dipole is constructed according to the exact specifications in the standards, including electrical and mechanical tolerance, the SAR targets specified in the standards may be used without separate numerical simulation. However, it is still necessary to conduct the initial experimental validation and regular calibration to reconfirm the SAR target. In situations when it can be demonstrated that an extended calibration interval is justified, longer calibration intervals for extending the annual calibration recommended by the SAR standards may be considered.

Dipoles are often optimized individually to provide the best impedance matching (50Ω) and return loss (≤ -20 dB) according to the tissue and phantom shell dielectric property requirements. This may introduce small differences between the specified and calibrated SAR targets for the individual dipole. Therefore, a dipole must be calibrated according to the specific phantom configuration and tissue properties required for routine measurements, especially at higher frequencies. Dipoles must also be calibrated using a fully validated SAR system according to the tissue dielectric parameters and SAR probe calibration range required for device testing. The Probe Calibration and System Verification application note in KDB 450824 continues to apply, in conjunction with this attachment, and must be considered in order to use a dipole at acceptable offset frequencies.

Calibration Requirements

The SAR system must be validated before it can be used for the initial dipole validation or subsequent dipole calibrations. According to measurement protocol, dipoles must be calibrated with a SAR system that has been fully validated at the measurement frequency. The measurement accuracy of the SAR system must also be verified with a calibrated dipole or equivalent source before performing any dipole calibration measurements. Since a calibrated dipole is required to validate the SAR system, it is unacceptable to calibrate a dipole with the same SAR system requiring that dipole to validate the SAR system. Documentation of dipole calibration and measurement integrity is required to support the calibration results; for example, electrical and SAR data, information and data on the SAR probe and

tissue dielectric parameters used in the dipole calibration and SAR system validation/verification status. The following are the recommended FCC procedures for SAR dipole calibration.

1) The phantom configuration, tissue dielectric parameters, dipole positioning requirements, dielectric spacer and other electrical and mechanical details should be clearly specified in the dipole calibration report. Dipoles must be recalibrated at least once every three years; however, immediate re-calibration is required for the following conditions. The test laboratory must ensure that the required supporting information and documentation have been included in the SAR report to qualify for the extended 3-year calibration interval; otherwise, the IEEE Standard 1528-2003 recommended annual calibration is expected.
   a) After a dipole is damaged and properly repaired to meet required specifications
   b) When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions; i.e. the error is not introduced by incorrect measurement procedures or other issues relating to the SAR measurement system
   c) When the most recent return-loss, measured at least annually, deviates by more than 20% from the previous measurement (i.e. 0.2 of the dB value) or not meeting the required -20 dB return-loss specification
   d) When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5 Ω from the previous measurement

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